The Relationship of Summer Thermocline Depth to Several Physical Characteristics of Lakes

D.R. Cruikshank

Western Region
Department of Fisheries and Oceans
Winnipeg, Manitoba R3T 2N6

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by

D.R. Cruikshank

Western Region
Department of Fisheries and Oceans
Winnipeg, Manitoba R3T 2N6

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ABSTRACT

Cruikshank, D.R. 1984. The relationship of summer thermocline depth to several physical characteristics of lakes. Can. Tech. Rep. Fish. Aquat. Sci. 1248: iv + 33 p.

Summer thermocline depths for 20 Experimental Lakes Area lakes are summarized. Significant relationships between thermocline depth (Z_t) and lake volume (V), area (A), fetch (F), mean depth ($\overline{z}$) and maximum depth (Z_{max}) are shown. Relationship to volume is given by $Z_t=3.02\ V^{0.17}$), (r=0.89), to area $Z_t=2.50\ A^{0.21}$ (r=0.84) and to fetch by $Z_t=0.32\ F^{0.40}$ (r=0.89) for the month of July. Epilimnion depths ranged from 52% to 89% of thermocline depth.

Key words: thermocline; fetch; lake volume.

RESUME

Cruikshank, D.R. 1984. The relationship of summer thermocline depth to several physical characteristics of lakes. Can. Tech. Rep. Fish. Aquat. Sci. 1248: iv + 33 p.

Ce rapport donne la profondeur estivale de la thermocline des vingt lacs de la Région des Lacs expérimentaux et établit des rapports significatifs entre la profondeur de la thermocline (Z_t) et le volume du lac (V), la superficie (A), la portée (F), la profondeur moyenne ($\overline{z}$) et la profondeur maximale (Z_{max}). En outre, il donne le rapport au volume comme étant $Z_t=3.02\ V^{0.17}$, (r=0.89), à la superficie come étant $Z_t=2.50\ A^{0.21}$ (r=0.84) et à la portée comme étant $Z_t=0.32\ F^{0.40}$ (r=0.89) pour le mois de juillet. La profondeur de l'épilimnion représentait de 52% à 89% de la profondeur de la thermocline.

Mots-clés: thermocline; portée; volume du lac.

INTRODUCTION

One of the most important physical characteristics of a lake is whether it stratifies or not. Stratification and thermocline depths are influenced by lake morphometry, meteorology and climate. However, in a small geographic area such as ELA morphometry is the most important influence. This report summarizes temperature data for 20 Experimental Lakes Area lakes in the form of summer thermocline depths.

ELA lakes stratify in much the same way as Minnesota lakes (Gorham 1980). Gorham's boundary line equation (Z_{max}=4.0 $A^{0.25}$) for determining the maximum depth required for a lake to stratify depending on its surface area also applied to ELA lakes. All four ELA lakes (103, 114, 303, 3828) that did not stratify plotted below the boundary line (Fig. 1) as predicted by the boundary line equation.

DATA COLLECTION AND METHODS

Temperature profiles of ELA lakes from 1969 to 1981 were taken using Montedoro-Whitney models TC-5A or TC-5C thermistors. All readings were corrected using a calibration curve. If temperatures changed by 1°C or more per 1 metre of depth, measurements were taken every quarter metre. Thermocline depths used in this report are values for the planar thermocline defined as the maximum rate of temperature change per unit depth (Hutchinson 1957). Epilimnion depths were determined as the region from the surface to a depth at which temperature change began to exceed 1°C per metre.

Temperature profiles were stored on disks for an HP 9828A calculator. Thermocline and epilimnion depths were calculated using computer analysis. Mean values were determined for July, August, July and August combined, and for the period July 25 to August 25 which was similar to the period used in the Minnesota study.

Thermocline depths for each period were calculated for each year that temperature profiles were taken. If there was more than one profile per period per year the mean value was used. Regression analyses of each physical parameter on thermocline depth for each time period were done on the logarithmic transformation of the thermocline data. Lake area (A), volume (V), mean depth ($\bar{z}$), and maximum depth (Z_{max}) were taken from bathymetric maps of ELA lakes (Table 1). Maximum lake fetch (F) was measured from the maps as the longest straight-line distance completely over water. Lake area varied from 1.67 to 56.10 ha, and mean depth varied from 1.5 to 15.1 m. There was also considerable variation in the basin shapes ranging from sub-circular to elongated lakes.

RESULTS

Lake area is closely related to maximum depth (Fig. 1). As lake area increases so does maximum depth. However, there is a depth as predicted by Gorham's boundary line equation below which lakes will not stratify. Four ELA lakes (103, 3828, 114, 303) did not stratify and appear below the boundary line (Fig. 1).

Epilimnion depth ranged from 52% to 89% of the thermocline depth (Table 1). Lakes with a surface area of 25 ha or greater had epilimnion depths that averaged 67% of the thermocline depth.

Thermoclines stabilized in July but increased in depth during the last half of August (Table 2) probably because heat losses to the atmosphere were increasing.

Thermocline depth was most strongly correlated with lake volume (r=0.89) and fetch (r=0.89). Weaker correlations were found between thermocline depth and lake area (r=0.84) mean depth (r=0.75) and maximum depth (r=0.72) (Table 3). Correlations were strongest for mean July thermocline depths. The correlation coefficients are significant at the 0.1% level.

The above relationships are for lakes with a surface area between 1.67 and 56.1 ha. When one larger lake (Lake 228, 1667 ha) was included in the data the correlation between thermocline depth and lake area became stronger (r=0.92). For the above analysis there were no data collected for lakes between 56 ha and 1677 ha. The analysis was then dominated by Lake 228 and therefore it was excluded from the data.

There is also a correlation between epilimnion depth and area (r=0.80), volume (r=0.85), fetch (re=0.84), mean depth (r=0.77) and maximum depth (r=0.69) (Table 4).

DISCUSSION

The relationships between thermocline depth and area or fetch of ELA lakes are similar

to those of 33 Minnesota lakes (Gorham, 1980). Gorham's equations relating thermocline depth to fetch ($Z_t = 5.8F^{0.37}$ where F is in km) are similar to those derived (Table 3) from temperature profiles in ELA lakes taken during the same time period as Gorham's study.

Gorham proposed that thermocline depth is affected by mean summer air temperatures (t_s) and latitude. Where air temperatures are warm there is a stronger gradient of solar heating for the wind to work against, therefore themocline depths should be shallower.

Thermocline depths were found to be shallowest in Japan (t_s=24°C), deepest in English lakes (t_s=15°C) and Minnesota lakes (t_s= 21°C) (Gorham 1980). The English lakes are located in mountainous country with strong prevailing winds which contributed to their deep thermoclines.

Using data from 16 profiles of 12 ELA lakes, including Lake 228, Gorham found that ELA lakes have shallower thermoclines than Minnesota lakes despite cooler air temperatures at ELA. This study, which covers 20 ELA lakes and 265 profiles over a 12 year period, found that ELA lakes up to 60 ha in area have deeper thermoclines than Minnesota lakes of the same size as expected from air temperatures (Fig. 2). The addition of Lake 228 to Gorham's studies did not accurately describe the mean thermoclines achieved by smaller ELA lakes.

The strong correlations between thermocline depth and volume or fetch suggests that boundary line equations such as Gorham's for lake area could be calculated for volume and fetch as well.

From this study, it is clear that thermocline depths are greatly influenced by the lakes' physical characteristics.

ACKNOWLEDGMENTS

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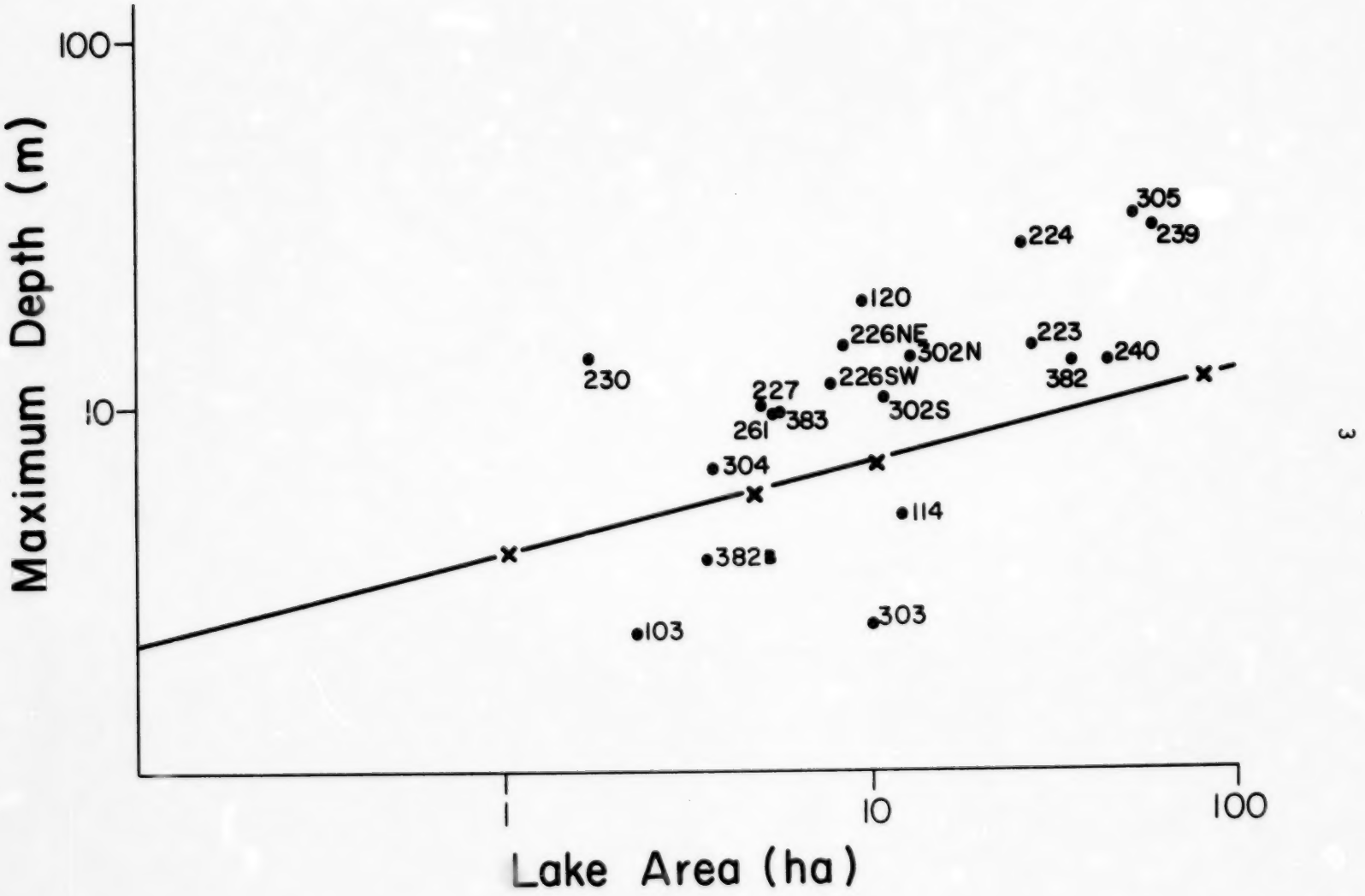


Fig. 1. Area vs. maximum depth showing Gorham's boundary line.

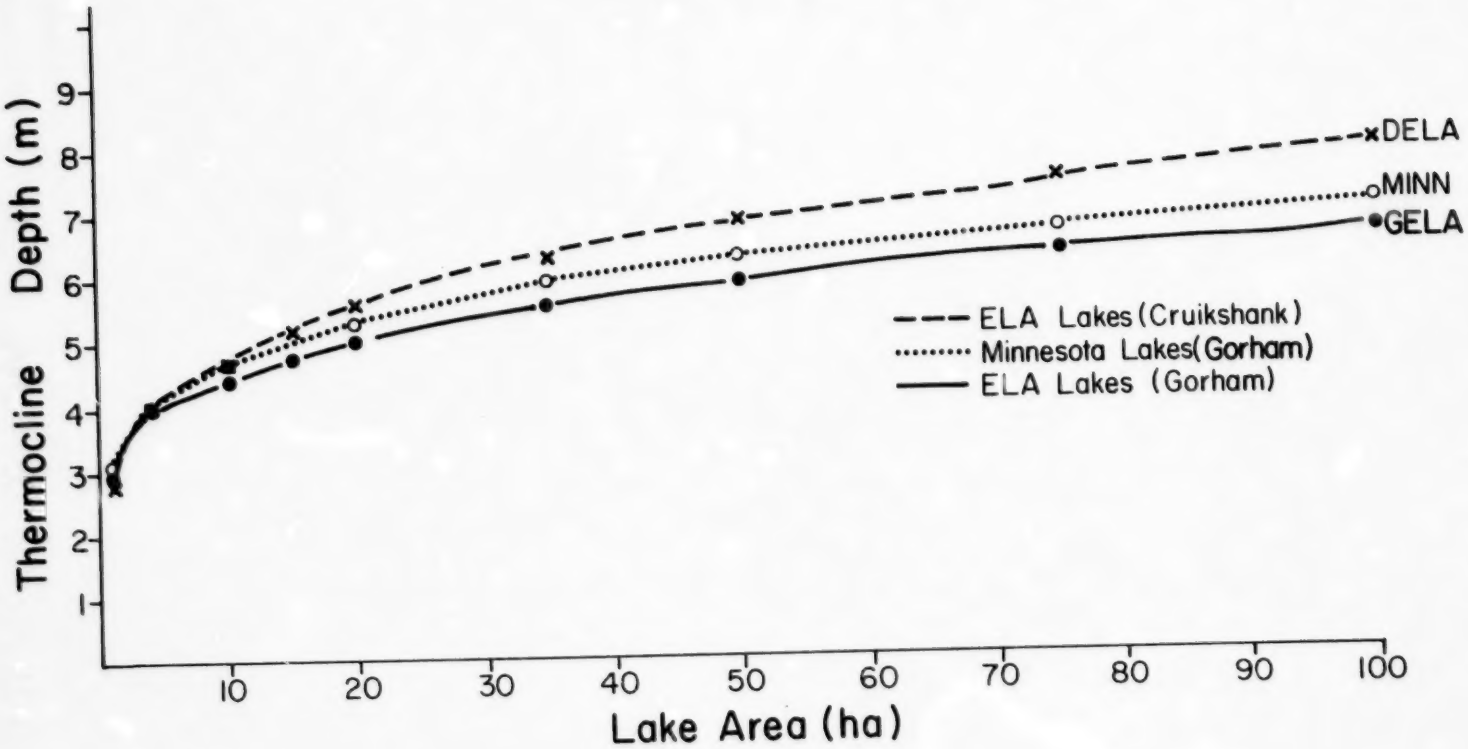


Fig. 2. Thermocline depth vs. lake area.

Table 1. Physical characteristics of selected E.L.A. lakes (Brunskill et al. 1971).

Lake	Area ($10^4 m^3$)	Fetch (m)	Volume ($10^4 m^3$)	Mean depth (m)	Max. depth (m)	Epil. depth (July) (m)	Mean thermocline depth (July) (m)	ED/TD
103	2.30	NA	NA	NA	2.4	NT	NT	
114	12.10	729	2.1	1.7	5.0	NT	NT	
120	9.31	790	7.0	7.5	19.0	3.25	4.44	0.73
223	27.27	760	19.5	7.1	14.4	4.89	5.69	0.86
224	25.92	920	30.1	11.6	27.4	5.52	6.20	0.89
226NE	8.33	543	4.7	5.7	14.7	2.56	4.13	0.62
226SW	7.77	526	4.9	6.3	11.6	3.03	4.32	0.70
227	5.00	296	2.2	4.4	10.0	1.88	2.64	0.71
230	1.67	275	1.0	5.9	13.6	2.23	2.96	0.75
239	56.10	1168	59.1	10.5	30.4	3.52	4.83	0.73
240	44.10	1069	26.7	6.1	13.1	4.25	5.31	0.80
261	5.57	500	1.6	2.9	9.6	2.34	3.42	0.68
302N	12.80	600	7.3	5.7	13.8	2.43	4.45	0.55
302S	10.90	613	5.5	5.0	10.6	3.67	5.03	0.73
303	9.93	696	1.5	1.5	2.5	NT	NT	
304	3.62	277	1.2	3.3	6.7	2.10	3.04	0.69
305	52.00	2129	78.6	15.1	32.7	5.33	6.22	0.86
382	35.60	960	NA	NA	13.0	3.63	4.39	0.83
382B	3.28	NA	NA	NA	3.8	NT	NT	
383	5.55	339	2.6	4.6	9.7	1.86	3.26	0.57

NA - Data not available
NT - No thermocline

Table 2. Comparison of mean thermocline depths for ELA lakes.

Lake	July (m)	August (m)	Gorham's study period July 25 - August 25 (m)	July & August (m)
120	4.44	4.50	4.19	4.53
223	5.69	6.98	6.54	6.56
224	6.20	8.06	7.61	7.18
226NE	4.13	4.83	4.80	4.54
226SW	4.32	5.01	4.81	4.66
227	2.64	3.21	2.72	2.96
230	2.96	3.97	3.60	3.31
239	4.83	5.58	5.53	5.19
240	5.31	5.85	5.81	5.58
261	3.42	4.08	4.05	3.79
302N	4.45	5.40	5.09	4.90
302S	5.03	6.03	5.66	6.29
304	3.04	3.67	3.38	3.27
305	6.22	7.75	7.67	6.90
382	4.39	5.88	5.50	5.09
383	3.26	4.13	4.13	3.69

Table 3. The relationship of thermocline depth (Z_+) in summer to several physical lake parameters.

Parameter	Minimum	Maximum	Time period	r	Regression
Area ($10^4 m^3$)	1.67	56.1	July	0.84	$Z_+ = 2.50\ A^{0.21}$
			August	0.80	$Z_+ = 3.09\ A^{0.20}$
			Jul 25-Aug 25	0.81	$Z_+ = 2.79\ A^{0.23}$
			July & August	0.83	$Z_+ = 2.76\ A^{0.21}$
Volume ($10^5 m^3$)	1.00	78.6	July	0.89	$Z_+ = 3.02\ V^{0.17}$
			August	0.83	$Z_+ = 3.70\ V^{0.17}$
			Jul 25-Aug 25	0.84	$Z_+ = 3.41\ V^{0.18}$
			July & August	0.87	$Z_+ = 3.33\ V^{0.17}$
Fetch (m)	275	2129	July	0.89	$Z_+ = 0.32\ F^{0.40}$
			August	0.82	$Z_+ = 0.44\ F^{0.38}$
			Jul 25-Aug 25	0.84	$Z_+ = 0.36\ F^{0.43}$
Mean depth (m)	2.9	15.1	July	0.75	$Z_+ = 1.94\ \bar{z}^{0.50}$
			August	0.76	$Z_+ = 2.16\ \bar{z}^{0.48}$
			Jul 25-Aug 25	0.60	$Z_+ = 1.00\ \bar{z}^{0.44}$
			July & August	0.77	$Z_+ = 1.98\ \bar{z}^{0.47}$
Max depth (m)	6.7	32.7	July	0.72	$Z_+ = 1.38\ Z_{max}^{0.47}$
			August	0.70	$Z_+ = 1.68\ Z_{max}^{0.42}$
			Jul 25-Aug 25	0.69	$Z_+ = 1.46\ Z_{max}^{0.45}$
			July & August	0.71	$Z_+ = 1.50\ Z_{max}^{0.42}$

Table 4. The relationship of July epilimnion depth (Z_e) to several physical lake parameters.

Parameter	r	Regression
Area	0.80	$Z_e = 1.54\ A^{0.28}$
Volume	0.85	$Z_e = 1.96\ V^{0.22}$
Fetch	0.84	$Z_e = 0.12\ F^{0.50}$
Mean Depth	0.77	$Z_e = 0.95\ \bar{z}^{0.56}$
Maximum Depth	0.69	$Z_e = 0.69\ Z_{max}^{0.56}$

APPENDIX 1

A tabulated presentation of yearly mean thermocline depths for the periods July, August, July 25 - Aug 25, and July and August combined.

All depths are in meters.

Numbers in brackets indicate number of temperature profiles used.

Mean thermocline depths.

Lake	Year	July	August	July and August	Jul 25-Aug 25
120	1969	5.00 (2)		5.00 (2)	
	1971	4.75 (1)	3.75 (1)	4.25 (2)	3.75 (1)
	1972	4.13 (1)	5.13 (1)	4.63 (2)	
	1974	3.87 (1)	4.63 (1)	4.25 (2)	4.63 (1)
	Mean	4.44	4.50	4.53	4.19
223	1974	4.13 (1)	5.88 (1)	5.01 (2)	5.88 (1)
	1975	5.13 (1)	6.25 (1)	5.69 (2)	5.69 (2)
	1976	6.13 (1)	7.00 (2)	6.71 (3)	6.71 (3)
	1977	5.66 (4)	7.69 (4)	6.68 (8)	7.13 (4)
	1978	4.71 (3)	6.63 (2)	5.48 (5)	5.88 (2)
	1979	4.88 (1)	6.88 (1)	5.88 (2)	6.88 (1)
	1980	7.41 (9)	8.07 (8)	7.34 (17)	7.18 (11)
	1981	6.26 (2)	7.88 (2)	7.07 (4)	7.38 (3)
	1982	6.25 (2)	7.29 (3)	6.87 (5)	6.75 (2)
	1983	6.29 (3)	6.20 (2)	6.25 (5)	5.88 (3)
	Mean	5.69	6.98	6.56	6.54
224	1974	5.13 (1)	7.50 (1)	6.32 (2)	7.50 (1)
	1975	6.13 (1)	9.50 (1)	7.82 (2)	7.82 (2)
	1976	6.63 (2)	8.01 (2)	7.32 (4)	7.71 (3)
	1977	6.32 (4)	8.64 (5)	7.57 (9)	7.98 (5)
	1978	6.13 (1)	7.63 (1)	6.88 (2)	7.63 (1)
	1981	7.01 (2)	8.13 (2)	7.57 (4)	8.38 (3)
	1982	6.75 (2)	7.54 (3)	7.23 (5)	7.00 (3)
	1983	5.38 (1)	7.13 (2)	6.54 (3)	6.54 (3)
	Mean	6.20	8.06	7.18	7.61
226NE	1973	4.76 (2)	5.26 (2)	5.01 (4)	5.26 (2)
	1974	3.26 (2)	4.63 (2)	3.94 (4)	4.63 (2)
	1975	3.76 (2)	4.63 (2)	4.19 (4)	4.63 (2)
	1976	4.38 (2)	5.21 (3)	4.88 (5)	5.33 (2)
	1977	4.01 (2)	4.88 (2)	4.44 (4)	4.46 (3)
	1978	3.38 (2)	4.46 (3)	4.03 (5)	4.51 (2)
	1979	4.38 (1)	4.63 (1)	4.51 (2)	4.51 (2)
	1980	4.38 (2)	4.63 (2)	4.88 (4)	4.63 (2)
	1981	4.76 (2)	5.88 (2)	5.32 (4)	5.88 (2)
	1982	4.25 (2)	4.13 (2)	4.19 (4)	4.21 (3)
	Mean	4.13	4.83	4.54	4.80
226SW	1973	4.51 (2)	5.26 (2)	4.88 (4)	5.13 (3)
	1974	3.63 (2)	5.01 (2)	4.32 (4)	5.01 (2)
	1975	4.01 (2)	4.63 (2)	4.32 (4)	4.63 (2)
	1976	4.88 (2)	4.88 (2)	4.88 (2)	4.76 (2)

Mean thermocline depths - continued.

Lake	Year	July	August	July and August	Jul 25-Aug 25
226SW (cont.)	1977	4.38 (2)	5.51 (2)	4.95 (4)	5.21 (3)
	1978	3.63 (3)	4.96 (3)	4.30 (6)	4.46 (3)
	1979	4.38 (1)	5.63 (1)	5.01 (2)	5.01 (2)
	1980	4.63 (2)	5.13 (2)	4.88 (4)	5.13 (2)
	1981	4.76 (2)	4.76 (2)	4.76 (4)	4.76 (2)
	1982	4.38 (3)	4.25 (2)	4.31 (4)	4.04 (3)
	Mean	4.32	5.01	4.66	4.81
227	1969	3.00 (3)	3.50 (1)	3.25 (4)	3.50 (1)
	1970	2.35 (4)	2.88 (4)	2.62 (8)	2.75 (5)
	1971	2.82 (4)	3.68 (5)	3.30 (9)	3.53 (5)
	1972	2.44 (4)	2.50 (3)	2.47 (7)	2.47 (4)
	1973	3.13 (2)	1.76 (2)	2.45 (4)	2.13 (3)
	1974	2.38 (3)	3.38 (2)	2.78 (5)	3.01 (2)
	1975	2.13 (2)	3.56 (4)	3.08 (6)	3.62 (3)
	1976	2.76 (2)	3.96 (3)	3.48 (5)	3.96 (3)
	1977	3.38 (2)	3.88 (2)	3.63 (4)	3.71 (3)
	1978	2.51 (2)	3.55 (3)	3.13 (5)	3.26 (2)
	1979	2.38 (1)	2.88 (1)	2.63 (2)	2.88 (1)
	1980	2.63 (3)	2.63 (2)	2.63 (5)	2.71 (3)
	1981	2.63 (2)	3.63 (2)	3.13 (4)	3.38 (3)
	1982	2.75 (2)	3.50 (3)	3.20 (5)	3.50 (2)
	1983	2.25 (2)	2.55 (3)	2.63 (5)	2.63 (2)
	Mean	2.64	3.21	2.96	2.72
228	1971	11.50 (1)	11.50 (1)	11.50 (2)	11.50 (2)
	1972	10.50 (1)	10.88 (1)	10.67 (2)	10.88 (1)
	1973		10.25 (1)	10.25 (1)	10.25 (1)
	1974		10.63 (2)	10.63 (2)	9.75 (1)
	Mean	11.00	10.82	10.76	10.60
230	1968	3.50 (1)		3.50 (1)	
	1969	2.50 (1)		2.50 (1)	
	1970	3.25 (1)	3.63 (1)	3.44 (2)	3.63 (1)
	1972		4.25 (1)	4.25 (1)	4.25 (1)
	1975	3.13 (2)	4.13 (1)	3.40 (3)	3.63 (1)
	1976	2.63 (1)	3.88 (1)	3.26 (2)	2.63 (1)
	Mean	2.96	3.97	3.31	3.60
239	1969	5.50 (3)	5.50 (1)	5.50 (4)	5.50 (1)
	1970	4.30 (5)	4.75 (1)	4.29 (6)	4.50 (2)
	1971	4.50 (3)	5.75 (4)	5.21 (7)	5.71 (2)
	1972	4.82 (2)	5.38 (1)	5.01 (3)	5.38 (1)

Mean thermocline depths - continued

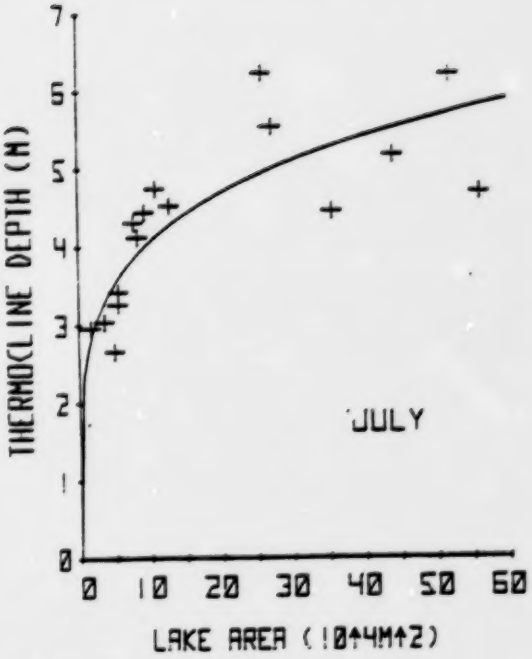
Lake	Year	July	August	July and August	Jul 25-Aug 25
239 (cont.)	1973	5.13 (2)	5.84 (3)	5.56 (5)	6.01 (2)
	1974	4.30 (3)	5.32 (4)	4.88 (7)	5.08 (5)
	1975	4.75 (1)	5.38 (1)	5.07 (2)	5.38 (1)
	1976	4.38 (1)	5.87 (1)	5.13 (2)	5.87 (1)
	1977	4.63 (1)	5.13 (1)	4.88 (2)	5.13 (1)
	1978	4.38 (1)	5.63 (1)	5.01 (2)	5.63 (1)
	1979	5.13 (1)	5.13 (1)	5.13 (2)	5.13 (1)
	1980	5.33 (8)	5.96 (8)	5.65 (16)	5.71 (8)
	1981	4.01 (2)	6.13 (2)	5.07 (4)	6.13 (2)
	1982	5.75 (2)	6.13 (2)	5.94 (4)	5.96 (3)
	1983	5.63 (1)	5.88 (1)	5.5 (2)	5.85 (1)
	Mean	4.83	5.58	5.19	5.50
240	1969	6.00 (1)	5.50 (1)	5.75 (2)	5.55 (1)
	1970	4.41 (4)	5.08 (4)	4.75 (8)	5.00 (3)
	1971	5.19 (2)	5.13 (3)	5.15 (5)	5.01 (2)
	1972	3.88 (1)	5.88 (1)	4.88 (2)	5.88 (1)
	1975	5.44 (2)	5.38 (1)	5.42 (3)	5.38 (1)
	1976	4.63 (1)	5.88 (1)	5.26 (2)	5.88 (1)
	1977	5.13 (1)	6.13 (1)	5.63 (2)	6.13 (1)
	1978	5.38 (1)	5.88 (1)	5.63 (2)	5.88 (1)
	1980	5.57 (4)	6.44 (4)	6.01 (8)	6.46 (3)
	1981	6.13 (2)	6.01 (2)	6.07 (4)	6.05 (3)
	1982	6.50 (2)	7.04 (3)	6.83 (5)	6.63 (2)
	1983	5.38 (1)	5.88 (1)	5.50 (2)	5.88 (1)
	Mean	5.31	5.85	5.58	5.81
261	1971	3.38 (1)	4.19 (2)	3.92 (3)	4.25 (1)
	1972	3.75 (1)	3.75 (1)	3.75 (2)	3.75 (1)
	1973	3.76 (4)	4.00 (4)	3.88 (8)	4.34 (3)
	1974	3.88 (1)	3.63 (1)	3.76 (2)	3.63 (1)
	1975	3.13 (3)	4.01 (2)	3.48 (5)	3.76 (2)
	1976	3.43 (5)	4.19 (4)	3.77 (9)	3.94 (4)
	1977	2.88 (1)	4.52 (2)	3.97 (3)	4.38 (1)
	1978	3.13 (1)	4.38 (1)	3.76 (2)	4.38 (1)
	Mean	3.42	4.08	3.79	4.05
302N	1972	4.69 (2)	5.57 (2)	5.13 (4)	5.42 (3)
	1973	5.21 (3)	6.03 (3)	5.65 (6)	6.18 (3)
	1974	4.26 (2)	6.13 (1)	4.88 (3)	4.63 (1)
	1975	3.88 (2)	4.76 (2)	4.32 (4)	4.76 (2)
	1976	4.13 (2)	5.63 (2)	4.88 (4)	5.21 (3)
	1978	4.38 (1)	5.63 (1)	5.01 (2)	5.01 (2)
	1980	5.19 (4)	5.71 (3)	5.42 (7)	5.51 (4)

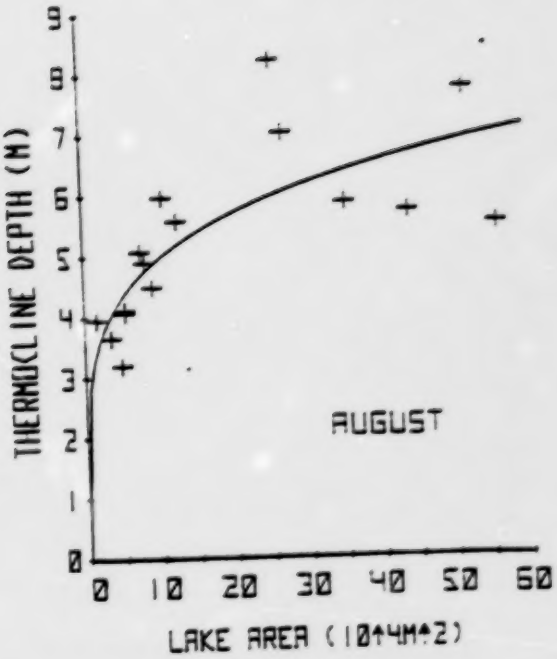
Mean thermocline depths - continued

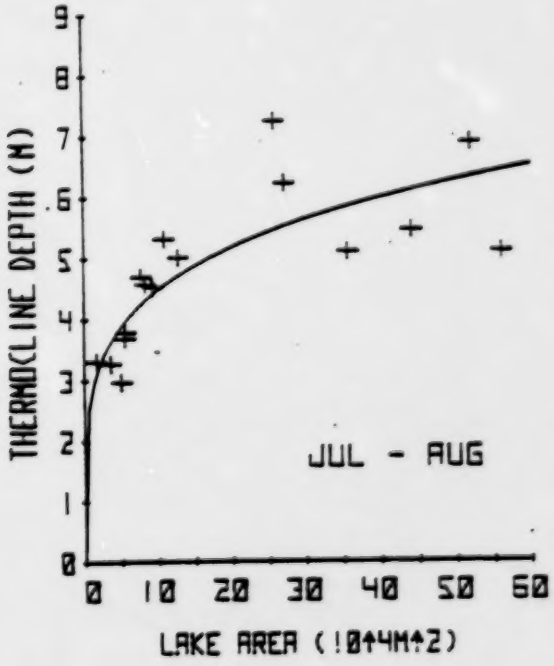
Lake	Year	July	August	July and August	Jul 25-Aug 25
302N (cont.)	1981	4.41 (2)	5.26 (2)	4.83 (4)	5.26 (2)
	1982	4.50 (2)	4.88 (2)	4.69 (4)	4.63 (3)
	1983	3.88 (2)	4.38 (3)	4.18 (5)	4.25 (4)
	Mean	4.45	5.40	4.90	5.09
302S	1972	4.75 (2)	5.69 (2)	5.22 (4)	5.33 (3)
	1973	4.96 (3)	5.51 (2)	5.18 (5)	5.63 (2)
	1974	4.01 (2)	5.88 (1)	4.63 (3)	4.63 (1)
	1975	4.63 (2)	5.01 (2)	4.82 (4)	5.01 (2)
	1976	4.76 (2)	6.63 (2)	5.69 (4)	6.13 (3)
	1978	4.88 (1)	6.38 (2)	5.63 (2)	5.01 (2)
	1980	5.71 (3)	6.63 (4)	6.24 (7)	6.38 (4)
	1981	3.19 (2)	6.13 (2)	5.16 (4)	6.13 (2)
	1982	5.25 (2)	5.75 (2)	5.50 (4)	5.71 (3)
	1983	7.13 (2)	6.71 (3)	6.83 (5)	6.69 (4)
	Mean	5.03	6.03	6.29	5.66
304	1969	3.17 (3)	3.5 (2)	3.30 (5)	3.50 (2)
	1970	2.75 (1)		2.75 (2)	2.75 (1)
	1971	3.38 (3)	3.57 (4)	3.49 (7)	3.53 (5)
	1972	3.38 (3)	3.63 (2)	3.48 (5)	3.63 (3)
	1973	3.38 (2)	3.38 (2)	3.38 (4)	3.38 (3)
	1974	2.63 (1)	3.63 (1)	3.13 (2)	3.63 (1)
	1975	3.01 (2)	3.88 (2)	3.45 (4)	3.26 (2)
	1976	2.51 (2)	3.26 (2)	2.88 (4)	3.26 (2)
	1977	3.13 (2)	3.92 (3)	3.60 (5)	3.44 (2)
	Mean	3.04	3.60	3.27	3.38
305	1968	6.50 (1)		6.50 (1)	
	1969	7.00 (2)	7.50 (1)	7.17 (3)	7.50 (1)
	1971	5.13 (1)	7.25 (1)	6.19 (2)	7.25 (1)
	Mean	6.22	7.75	6.90	7.67
382	1977	5.88 (1)	6.13 (2)	6.05 (3)	5.63 (1)
	1978	4.13 (1)	5.63 (1)	4.88 (2)	5.63 (1)
	1979	4.40 (2)	6.13 (1)	4.98 (3)	
	1980	3.38 (1)	5.63 (1)	4.51 (2)	5.63 (1)
	1983	4.13 (1)	5.83 (1)	5.00 (2)	5.00 (2)
	Mean	4.39	5.88	5.09	5.50
383	1974	2.88 (1)	3.38 (1)	3.13 (2)	3.38 (1)
	1975	3.63 (1)	4.88 (1)	4.26 (2)	4.88 (1)
	Mean	3.26	4.13	3.69	4.13

APPENDIX 2

Graphical presentation of the relationships between thermocline depth and physical lake characteristics.


THERMOCLINE DEPTH (M)
JULY
LAKE AREA (10↑4M↑2)


THERMOCLINE DEPTH (M)
AUGUST
LAKE AREA (10↑4M↑2)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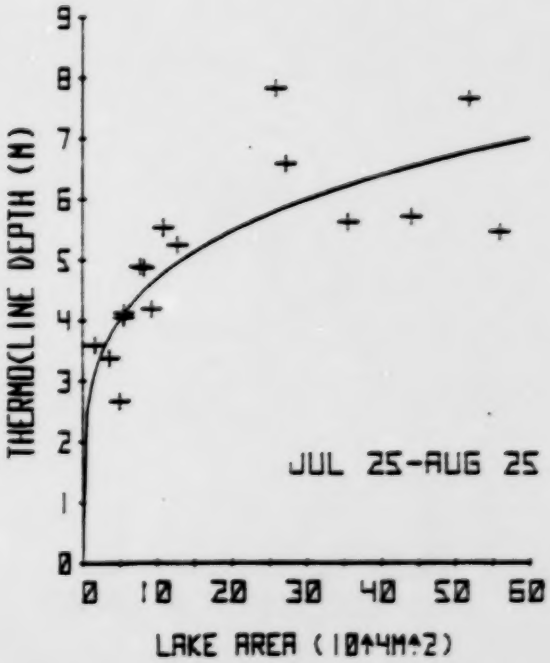
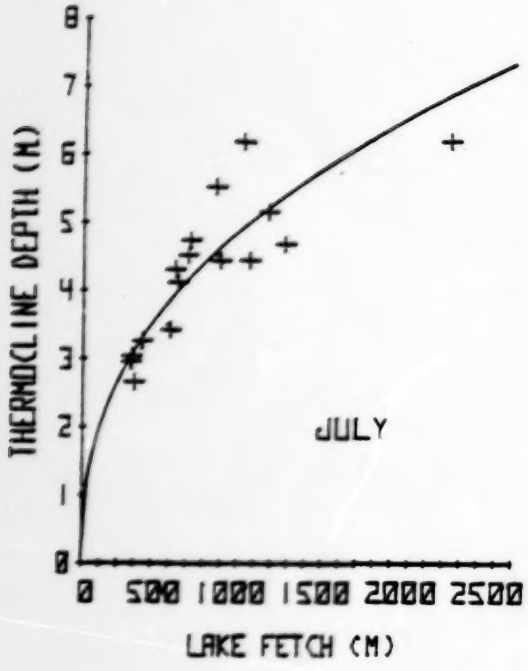
JUL - AUG
LAKE AREA (10↑4M↑2)


THERMOCLINE DEPTH (M)
JUL 25-AUG 25
LAKE AREA (10↑4M↑2)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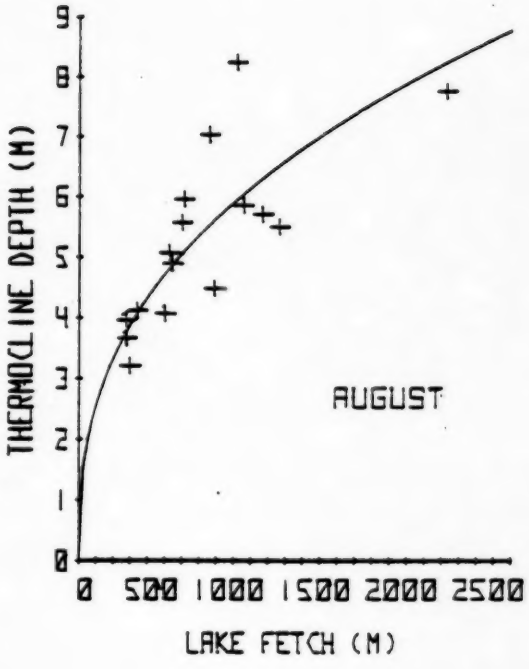
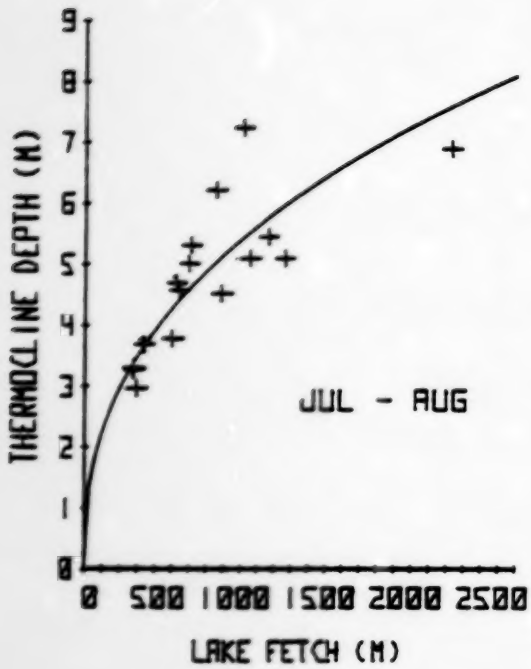
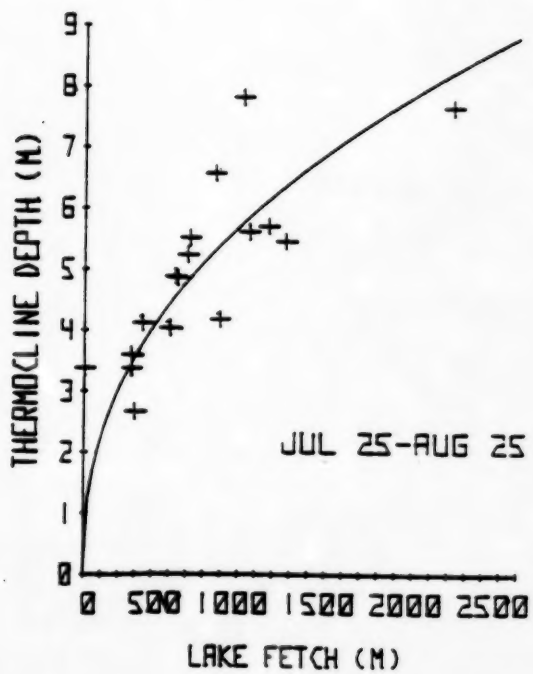
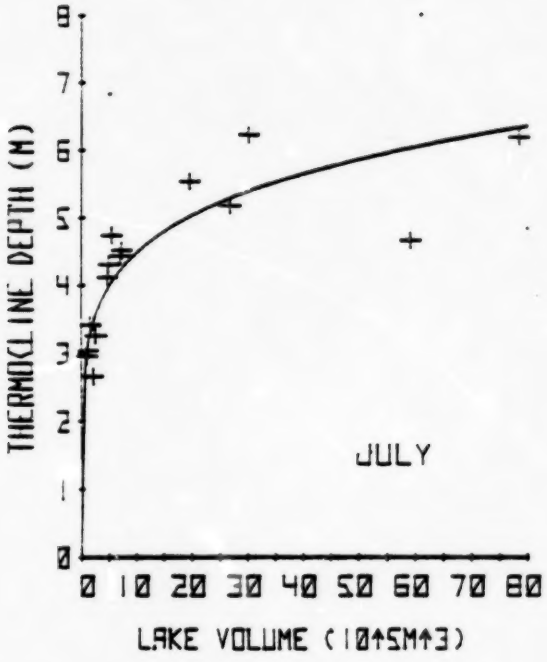
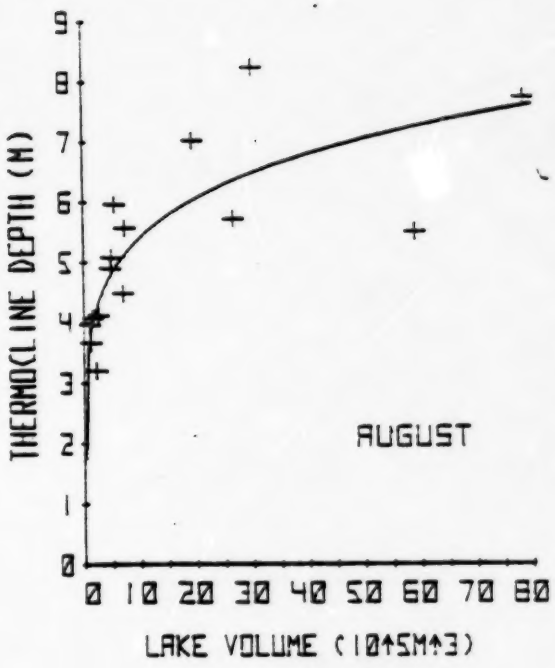
JULY
0 500 1000 1500 2000 2500
LAKE FETCH (M)


THERMOCLINE DEPTH (M)
0 1 2 3 4 5 6 7 8 9
AUGUST
0 500 1000 1500 2000 2500
LAKE FETCH (M)


THERMOCLINE DEPTH (M)
0 1 2 3 4 5 6 7 8 9
JUL - AUG
0 500 1000 1500 2000 2500
LAKE FETCH (M)


THERMOCLINE DEPTH (M)
0 1 2 3 4 5 6 7 8 9
JUL 25-AUG 25
0 500 1000 1500 2000 2500
LAKE FETCH (M)


THERMOCLINE DEPTH (M)
JULY
LAKE VOLUME (10↑5M↑3)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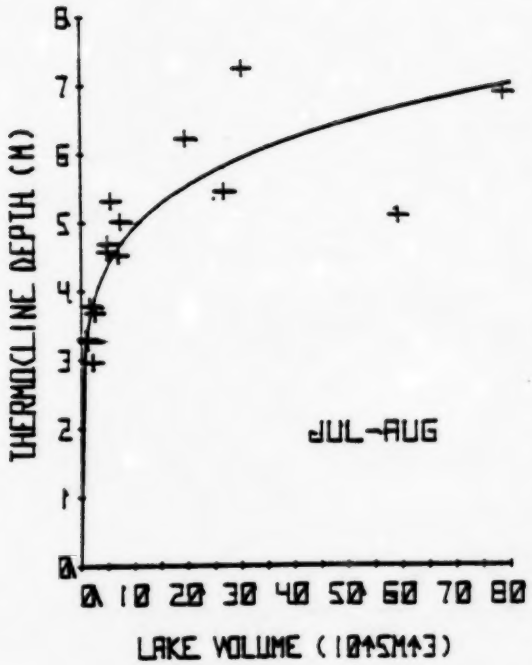
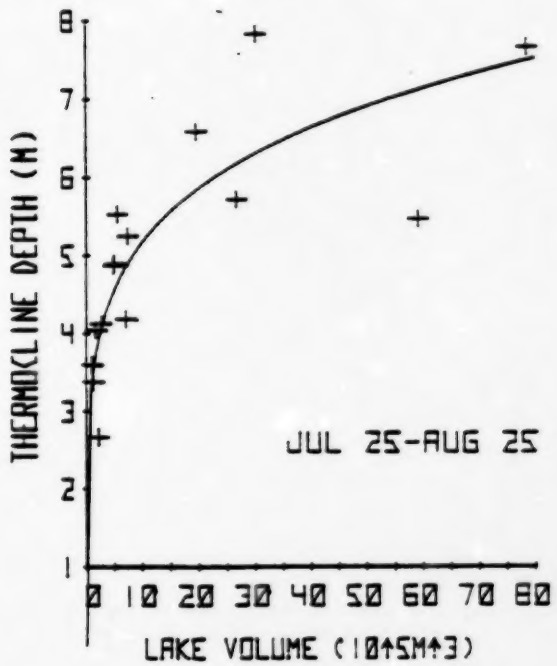
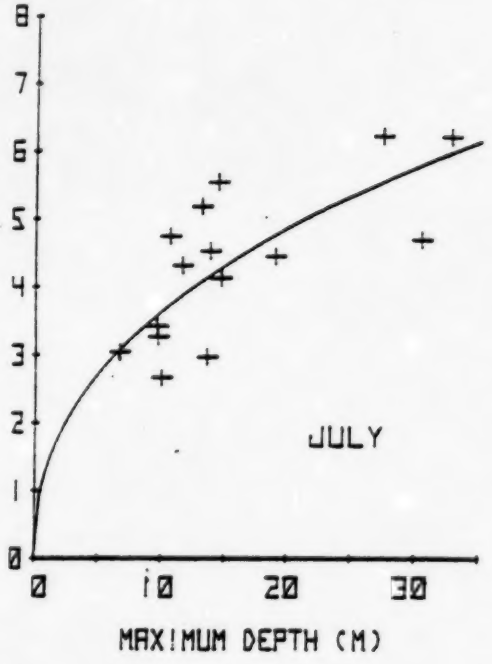
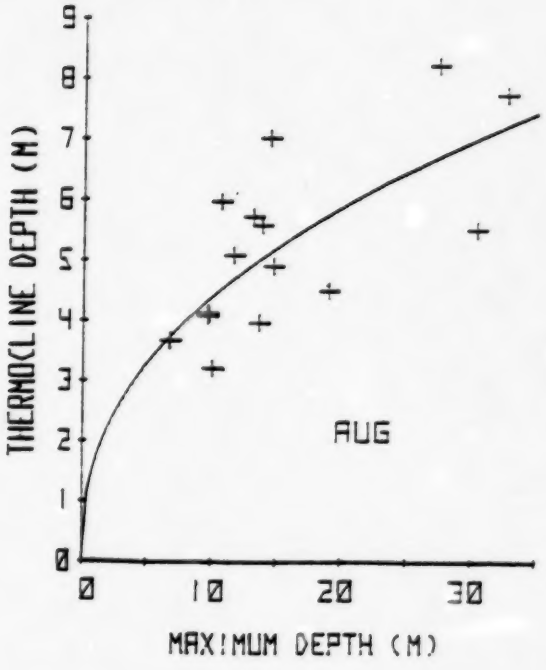
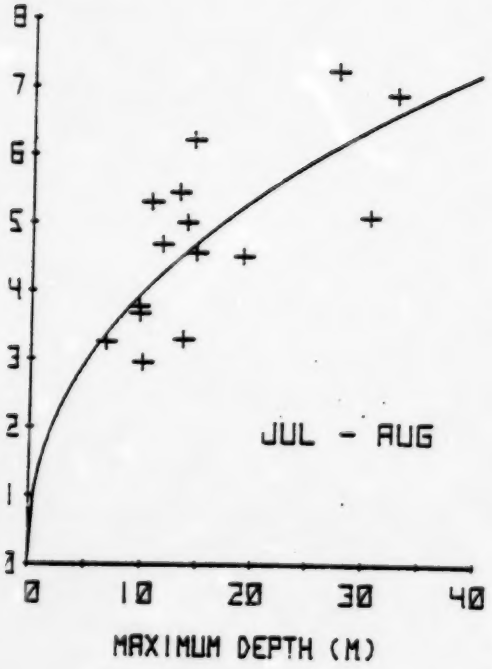
AUGUST
LAKE VOLUME (10↑5M↑3)

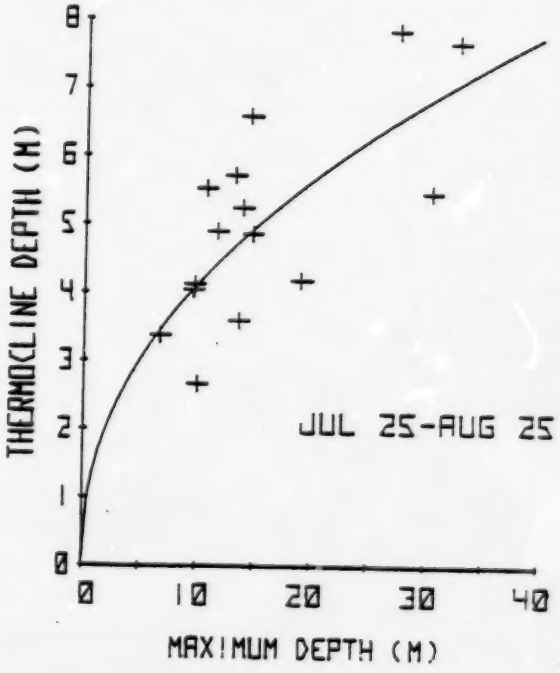

THERMOCLINE DEPTH (M)
JUL-AUG
LAKE VOLUME (10↑5M↑3)

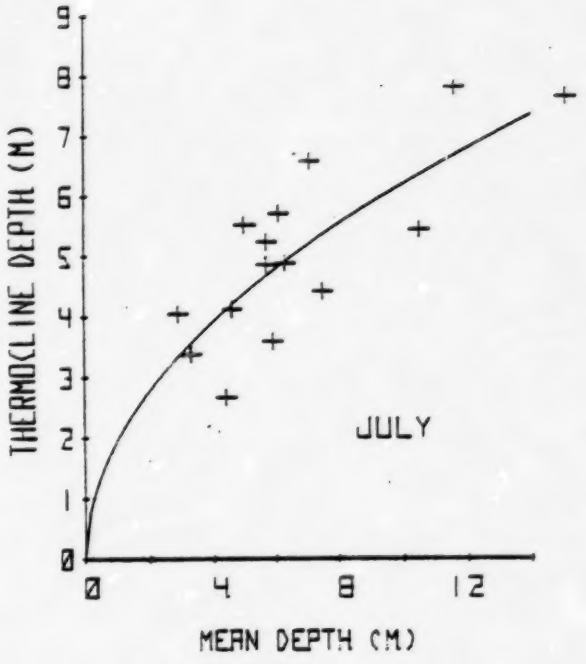

THERMOCLINE DEPTH (M)
JUL 25-AUG 25
LAKE VOLUME (10↑5M↑3)


JULY
MAXIMUM DEPTH (M)


THERMOCLINE DEPTH (M)
AUG
MAXIMUM DEPTH (M)


JUL - AUG
MAXIMUM DEPTH (M)


THERMOCLINE DEPTH (M)
JUL 25-AUG 25
MAXIMUM DEPTH (M)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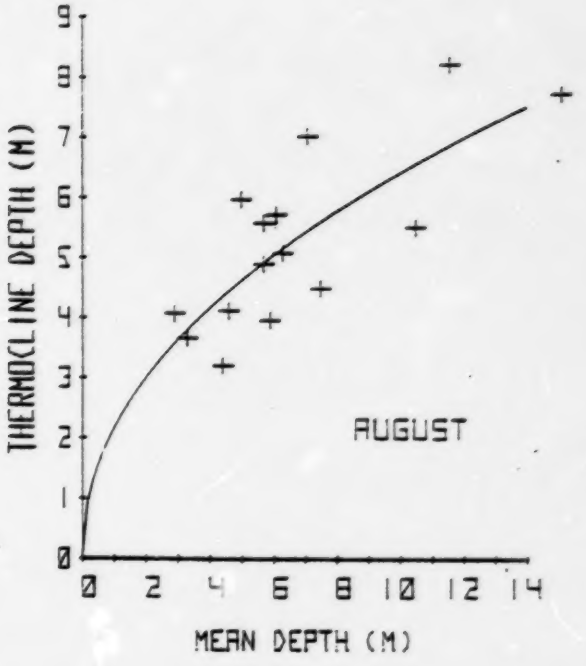
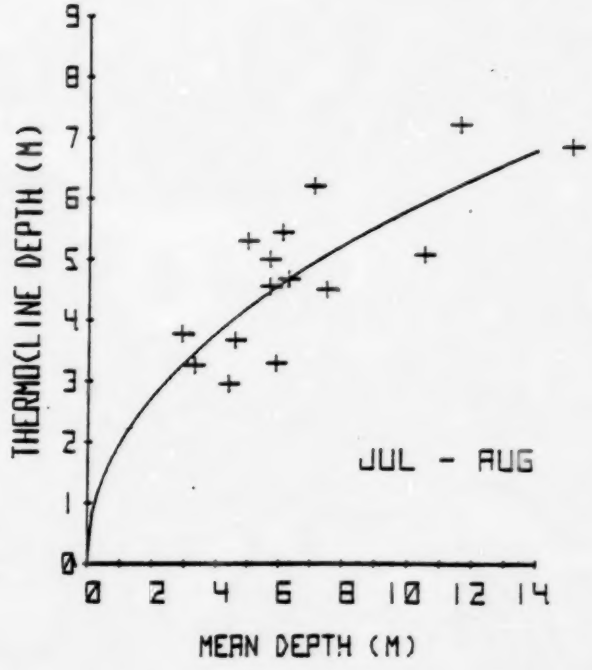
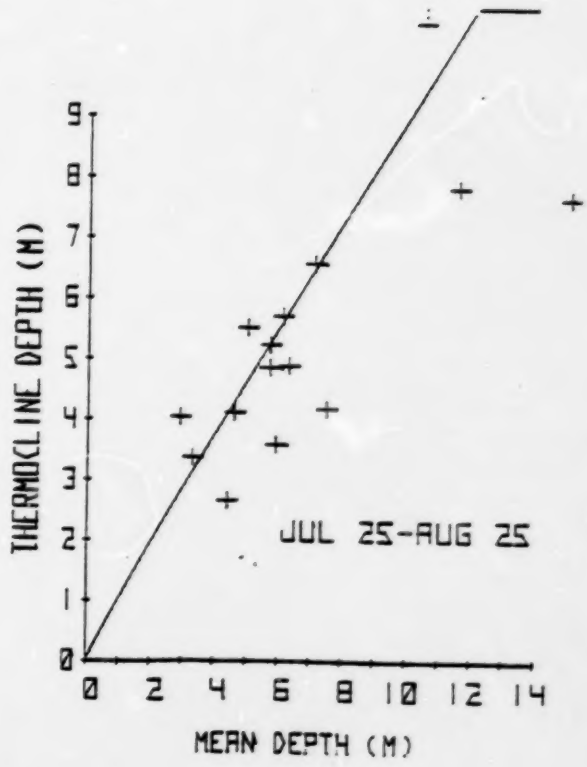
0 1 2 3 4 5 6 7 8 9
0 4 8 12
MEAN DEPTH (M)
JULY


THERMOCLINE DEPTH (M)
0 1 2 3 4 5 6 7 8 9
0 2 4 6 8 10 12 14
MEAN DEPTH (M)
AUGUST


THERMOCLINE DEPTH (M)
0 1 2 3 4 5 6 7 8 9
0 2 4 6 8 10 12 14
MEAN DEPTH (M)
JUL - AUG


THERMOCLINE DEPTH (M)
0 1 2 3 4 5 6 7 8 9
0 2 4 6 8 10 12 14
MEAN DEPTH (M)
JUL 25-AUG 25

APPENDIX 3

Thermocline and temperature data of ELA lakes for each sampling date during July and August. Temperatures are in degrees celsius and depths in meters.

Lake	Day	Year	Surface temp	Epi temp	Epi depth	Planar thermocline
120						
	187	1969	17.50	17.50	4.50	5.50
	201	1969	21.60	21.70	2.50	4.50
	200	1971	21.10	21.10	3.50	4.75
	235	1971	20.00	19.70	2.50	3.75
	206	1972	20.64	20.64	3.50	4.12
	241	1972	20.98	21.03	3.50	5.12
	199	1974	24.13	24.15	2.50	3.87
	227	1974	19.81	19.81	4.12	4.62
223						
	198	1974	23.40	23.40	3.50	4.12
	226	1974	20.30	20.30	5.12	5.87
	209	1975	21.89	21.91	4.62	5.12
	237	1975	18.93	18.99	5.75	6.25
	194	1976	22.28	22.25	4.75	6.12
	208	1976	21.88	21.87	5.50	6.12
	222	1976	21.38	21.37	6.12	6.62
	236	1976	22.17	22.19	5.87	7.37
	185	1977	20.96	20.96	4.75	5.25
	192	1977	20.66	20.68	4.75	5.62
	199	1977	22.15	22.15	5.25	5.62
	206	1977	22.41	22.41	5.12	6.12
	213	1977	20.34	20.39	6.25	9.37
	220	1977	19.73	19.68	6.12	6.87
	227	1977	17.98	18.03	7.12	7.62
	234	1977	17.47	17.57	7.25	7.87
	241	1977	17.15	17.20	7.75	8.37
	184	1978	21.49	21.51	3.12	3.12
	198	1978	21.38	21.38	4.25	5.37
	212	1978	19.58	19.58	5.62	5.62
	226	1978	20.69	20.69	5.12	6.12
	240	1978	18.32	18.32	6.25	7.12
	197	1979	21.16	21.19	4.87	4.87
	225	1979	19.46	19.48	6.62	6.87
	210	1980	21.85	21.89	6.62	7.62
	238	1980	21.38	21.38	8.12	8.37
	194	1981	23.52	23.42	3.25	6.12
	208	1981	21.10	21.11	6.12	6.37
	222	1981	22.54	22.51	6.12	7.37
	236	1981	19.67	19.64	7.12	8.37

Lake	Day	Year	Surface temp	Epi temp	Epi depth	Planar thermocline
	186	1982	18.84	18.81	6.12	6.37
	200	1982	20.55	20.55	5.62	6.12
	214	1982	21.43	21.47	6.12	6.12
	228	1982	20.86	20.99	6.12	7.37
	242	1982	17.05	17.08	7.87	8.37
	185	1983	19.00	19.00	4.87	7.12
	192	1983	21.90	22.00	4.12	6.37
	206	1983	22.80	22.80	4.37	5.37
	220	1983	24.00	24.10	5.37	5.37
	234	1983	20.70	20.70	6.62	6.87
224						
	198	1974	23.70	23.70	5.12	5.12
	226	1974	20.45	20.42	6.50	7.50
	209	1975	22.13	22.06	6.12	6.12
	237	1975	19.22	19.22	7.50	9.50
	185	1977	20.96	20.85	5.25	6.12
	192	1977	20.71	20.71	5.25	6.62
	199	1977	22.00	22.04	5.75	6.12
	206	1977	22.32	22.41	5.50	6.37
	213	1977	19.98	20.03	6.75	7.62
	220	1977	20.00	20.02	7.12	8.12
	227	1977	17.86	17.94	8.12	8.62
	234	1977	17.70	17.72	8.62	9.12
	241	1977	17.24	17.26	8.12	9.37
	191	1978	20.58	20.69	4.75	6.12
	219	1978	19.37	19.35	7.12	7.62
	194	1981	23.13	22.77	5.12	5.12
	208	1981	21.50	21.40	6.25	8.87
	222	1981	22.52	22.52	7.12	7.12
	236	1981	21.77	21.79	7.75	9.12
	186	1982	19.58	19.13	5.12	7.12
	200	1982	20.53	20.51	6.12	6.37
	214	1982	21.21	21.24	6.12	6.37
	228	1982	21.08	20.93	6.62	7.62
	242	1982	17.52	17.51	8.12	8.62
	206	1983	22.60	22.50	5.37	5.37
	227	1983	23.10	23.10	6.12	6.62
	234	1983	20.60	20.60	7.12	7.62
226 NE						
	191	1973	22.45	22.25	3.50	4.87
	205	1973	21.62	21.69	3.50	4.62
	219	1973	22.15	22.20	3.50	5.12
	233	1973	22.18	22.06	3.50	5.37

Lake	Day	Year	Surface temp	Epi temp	Epi depth	Planar thermocline
	190	1974	23.69	23.70	2.50	3.12
	204	1974	24.25	24.10	3.12	3.37
	218	1974	21.35	21.25	4.12	4.62
	229	1974	19.85	19.75	4.12	4.62
	188	1975	25.78	25.75	2.12	3.37
	202	1975	22.63	22.63	3.12	4.12
	216	1975	22.26	22.32	3.12	4.37
	230	1975	18.92	18.88	4.37	4.87
	244	1975	18.29	18.26	4.12	5.37
	187	1976	23.54	23.39	1.50	4.37
	201	1976	22.07	21.82	3.62	4.37
	215	1976	21.60	21.58	3.62	4.62
	229	1976	20.36	20.32	4.12	6.12
	243	1976	19.65	19.45	4.62	4.87
	194	1977	20.95	20.95	3.12	4.37
	208	1977	22.68	22.63	3.12	3.62
	222	1977	19.38	19.48	3.75	4.62
	236	1977	16.59	16.74	5.12	5.12
	186	1978	22.21	22.23	2.12	2.87
	200	1978	21.37	21.43	2.12	3.87
	214	1978	19.53	19.53	3.12	4.87
	228	1978	20.48	20.48	2.87	4.12
	242	1978	17.30	17.30	3.37	4.37
	206	1979	22.85	22.94	2.87	4.37
	234	1979	21.39	21.39	2.12	4.62
	191	1980	21.50	21.40	3.12	4.87
	205	1980	22.75	22.68	3.12	3.87
	219	1980	20.51	20.51	4.12	4.37
	233	1980	22.00	22.53	1.12	4.87
	189	1981	25.25	25.30	2.12	5.37
	203	1981	22.50	22.55	3.50	4.12
	217	1981	23.12	23.04	3.50	4.87
	231	1981	18.70	18.70	4.75	6.87
	195	1982	21.16	21.16	2.62	4.12
	209	1982	23.02	22.93	2.62	4.37
	223	1982	19.51	19.55	3.50	4.12
	237	1982	19.29	19.32	4.12	4.12
226 SW						
	191	1973	22.06	22.00	3.25	4.87
	205	1973	21.59	21.64	3.50	4.12
	219	1973	22.20	22.20	2.50	4.87
	233	1973	22.07	22.05	3.50	5.62

Lake	Day	Year	Surface temp	Epi temp	Epi depth	Planar thermocline
	190	1974	23.41	23.40	2.50	3.87
	204	1974	23.90	23.85	3.12	3.37
	218	1974	20.80	20.65	4.12	4.87
	229	1974	19.79	19.79	4.62	5.12
	188	1975	25.62	25.60	2.25	3.87
	202	1975	22.53	22.63	3.12	4.12
	216	1975	22.21	22.32	3.37	4.37
	230	1975	19.01	19.01	4.37	4.87
	244	1975	18.25	18.25	4.12	5.50
	187	1976	23.08	22.93	2.25	5.12
	201	1976	21.95	21.89	4.12	4.62
	215	1976	21.55	21.55	4.12	4.37
	229	1976	20.34	20.30	4.62	5.12
	243	1976	19.65	19.60	5.12	5.12
	194	1977	20.95	20.95	3.25	4.12
	208	1977	22.78	22.73	3.12	4.62
	222	1977	19.38	19.48	4.12	4.87
	236	1977	17.12	17.10	4.62	6.12
	186	1978	22.13	22.13	2.25	3.87
	200	1978	21.30	21.34	3.12	3.37
	214	1978	19.90	19.92	3.62	4.37
	228	1978	20.57	20.58	3.62	5.62
	242	1978	18.09	18.11	4.12	4.87
	206	1979	22.66	22.70	3.12	4.37
	234	1979	20.88	20.88	2.12	5.62
	191	1980	21.34	21.28	3.12	4.87
	205	1980	22.60	22.53	3.12	4.37
	219	1980	20.61	20.63	4.37	4.62
	233	1980	22.27	22.24	1.87	5.62
	203	1981	22.80	22.80	3.37	4.37
	217	1981	23.20	23.20	3.50	4.62
	219	1981	25.18	25.18	1.25	5.12
	231	1981	17.69	17.69	4.12	4.87
	195	1982	21.14	21.14	2.62	5.12
	209	1982	23.15	23.15	2.62	3.12
	223	1982	19.16	19.21	3.62	4.12
	237	1982	19.36	19.44	3.50	4.37
227						
	188	1969	18.10	18.10	2.50	3.50
	198	1969	18.10	22.45	2.50	5.50
	203	1969	22.70	22.70	2.50	2.50
	234	1969	22.90	22.50	1.50	3.50

Lake	Day	Year	Surface temp	Epi temp	Epi depth	Planar thermocline
	188	1970	22.73	22.75	1.50	2.87
	195	1970	26.00	25.90	1.25	2.12
	202	1970	22.95	22.72	1.50	2.12
	209	1970	24.42	23.50	1.25	2.25
	216	1970	19.98	20.06	2.25	2.75
	223	1970	24.38	24.13	1.50	2.75
	230	1970	20.83	20.87	2.25	2.75
	237	1970	19.87	19.77	2.25	3.25
	244	1970	17.90	17.90	2.50	3.25
	187	1971	21.53	21.47	2.12	2.62
	194	1971	20.38	20.40	2.12	2.37
	201	1971	21.95	21.25	2.37	2.87
	208	1971	18.83	18.83	2.50	3.37
	215	1971	17.35	16.97	3.12	3.87
	222	1971	21.90	22.05	1.50	3.62
	229	1971	19.67	19.64	2.50	3.12
	236	1971	19.35	19.48	2.50	3.62
	243	1971	20.18	19.65	0.25	4.12
	186	1972	19.53	18.96	1.50	2.37
	193	1972	22.31	21.71	1.50	2.12
	200	1972	21.12	20.96	1.75	2.87
	207	1972	19.65	19.26	1.75	2.37
	221	1972	17.48	17.53	2.25	2.62
	228	1972	18.83	18.83	2.25	2.75
	235	1972	21.33	20.35	0.25	2.12
	190	1973	22.94	22.29	1.50	3.37
	204	1973	22.84	22.49	1.25	2.87
	218	1973	22.16	22.14	1.37	1.37
	232	1973	21.87	21.90	1.50	2.12
	183	1974	22.05	21.59	1.12	2.12
	197	1974	23.70	23.32	2.12	2.12
	211	1974	18.62	18.68	2.37	2.87
	225	1974	19.90	19.88	2.12	3.12
	239	1974	15.95	15.99	3.12	3.62
	189	1975	22.96	23.67	1.50	2.12
	203	1975	22.89	22.74	2.12	2.12
	217	1975	21.26	21.37	2.25	2.87
	231	1975	18.20	18.23	2.50	3.87
	237	1975	18.90	18.87	2.12	4.12
	240	1975	19.46	18.38	0.87	3.37
	244	1975	18.70	18.67	2.62	3.12
	188	1976	23.88	23.72	1.87	2.12
	202	1976	21.81	21.78	2.12	3.37
	216	1976	21.51	21.41	2.62	3.62
	230	1976	20.23	20.19	2.50	4.37
	244	1976	18.71	18.76	0.25	0.75

Lake	Day	Year	Surface temp	Epi temp	Epi depth	Planar thermocline
	193	1977	20.60	20.62	2.12	3.37
	207	1977	22.26	22.26	2.25	3.37
	221	1977	20.19	20.19	2.50	3.12
	235	1977	16.59	16.69	3.12	4.62
	185	1978	22.99	22.72	1.62	2.12
	199	1978	22.01	22.14	1.25	2.87
	213	1978	19.70	19.70	2.12	2.87
	227	1978	22.02	22.04	1.75	3.62
	241	1978	17.81	17.81	2.12	4.12
	198	1979	20.02	20.06	1.87	2.37
	226	1979	17.10	17.12	2.62	2.87
	183	1980	17.77	17.84	2.12	2.62
	211	1980	21.50	21.42	1.87	2.87
	239	1980	20.10	20.20	2.12	2.37
	195	1981	23.90	23.68	1.25	2.37
	209	1981	20.64	20.55	2.12	2.87
	223	1981	21.87	21.84	2.12	2.87
	237	1981	21.61	21.61	2.12	4.37
	187	1982	20.35	19.87	1.12	2.87
	201	1982	21.16	21.14	1.62	2.62
	215	1982	19.85	19.85	2.12	3.62
	229	1982	21.42	21.32	1.12	3.37
	243	1982	14.59	14.63	3.50	3.50
	186	1983	16.80	16.60	2.12	2.62
	200	1983	24.70	24.40	1.12	1.87
	214	1983	23.30	23.30	1.37	2.62
	228	1983	22.30	22.40	2.12	2.62
	242	1983	21.55	21.55	2.12	3.37
228						
	207	1971	18.00	18.10	9.50	11.50
	228	1971	18.31	18.31	11.50	11.50
	203	1972	20.80	20.20	9.50	10.50
	231	1972	21.20	20.80	2.50	10.87
	213	1973	20.80	19.60	0.50	10.25
	192	1974	20.60	20.58	3.50	3.50
	213	1974	19.00	19.00	9.75	9.75
	240	1974	16.85	16.90	11.50	11.50
230						
	187	1968	20.20	19.00	0.50	3.50
	201	1969	22.60	22.40	1.50	2.50

Lake	Day	Year	Surface temp	Epi temp	Epi depth	Planar thermocline
	244	1970	18.00	18.00	3.50	3.50
	206	1972	20.71	20.74	2.50	3.25
	241	1972	21.31	21.31	2.50	4.25
	211	1975	23.58	23.47	2.50	3.62
	238	1975	18.50	18.56	3.12	4.12
	209	1976	23.18	22.93	2.37	2.62
	240	1976	23.48	23.56	2.12	3.87
239						
	183	1969	17.00	16.90	4.50	5.50
	189	1969	17.40	17.50	3.50	5.50
	194	1969	23.00	22.48	1.50	5.50
	237	1969	23.30	23.30	3.50	5.50
	189	1970	20.89	20.88	3.12	4.12
	196	1970	22.90	23.06	3.37	4.12
	205	1970	21.64	21.62	4.12	4.62
	210	1970	23.56	23.55	2.50	4.25
	236	1970	20.28	20.18	4.75	4.75
	186	1971	20.52	20.40	3.50	4.50
	196	1971	20.50	20.40	4.12	4.87
	214	1971	16.71	16.75	5.62	5.62
	224	1971	20.65	20.61	3.25	5.87
	238	1971	18.85	19.00	5.12	5.62
	242	1971	19.67	19.67	4.12	5.87
	187	1972	20.82	20.66	3.50	4.75
	192	1972	20.61	20.61	3.25	4.87
	227	1972	19.81	19.81	4.25	5.37
	185	1973	18.90	18.90	4.12	4.87
	199	1973	20.78	20.78	4.12	5.37
	213	1973	20.00	19.68	4.50	5.62
	227	1973	21.32	21.39	4.25	6.37
	241	1973	22.83	22.79	3.50	5.50
	190	1974	23.95	23.90	2.25	4.62
	197	1974	23.95	23.88	3.25	4.12
	206	1974	23.16	23.15	3.75	4.12
	214	1974	19.08	19.08	4.25	4.62
	220	1974	22.30	22.30	3.25	5.87
	232	1974	18.65	18.70	4.87	5.62
	234	1974	19.75	19.70	4.25	5.12
	195	1975	20.49	20.49	4.25	4.75
	223	1975	20.42	20.42	5.12	5.37

Lake	Day	Year	Surface temp	Epi temp	Epi depth	Planar thermocline
	195	1976	21.84	21.90	4.12	4.37
	223	1976	20.86	20.88	4.87	5.87
	193	1977	19.80	19.90	3.25	4.62
	221	1977	19.98	19.98	4.75	5.12
	199	1978	21.52	21.52	2.37	4.37
	227	1978	21.13	21.16	3.62	5.62
	192	1979	23.87	23.80	2.37	5.12
	220	1979	20.46	20.59	4.62	5.12
	184	1980	18.18	18.17	5.12	5.12
	205	1980	22.32	22.25	4.37	5.12
	233	1980	21.78	21.78	2.12	5.62
	189	1981	24.58	24.58	2.87	3.12
	203	1981	22.76	22.75	4.12	4.87
	217	1981	23.01	22.98	4.12	6.37
	231	1981	21.74	21.77	5.12	5.87
	195	1982	21.12	21.12	1.50	5.87
	209	1982	23.01	23.01	4.12	5.62
	223	1982	19.21	19.23	5.12	6.12
	237	1982	19.09	19.24	6.12	6.12
	200	1983	24.60	24.60	3.37	5.37
	228	1983	22.00	22.00	5.12	5.87
240						
	183	1969	16.60	16.50	5.50	6.50
	189	1969	17.50	17.60	4.50	5.50
	237	1969	23.35	23.30	4.50	5.50
	189	1970	21.42	21.42	3.25	4.87
	196	1970	23.43	23.43	2.50	3.87
	203	1970	22.15	22.18	3.87	3.87
	210	1970	23.75	23.70	2.50	5.25
	217	1970	21.03	21.00	4.25	5.25
	224	1970	24.58	24.38	4.25	4.25
	231	1970	20.89	21.01	4.50	5.50
	238	1970	19.98	19.98	4.50	5.25
	186	1971	21.11	21.11	4.50	5.25
	196	1971	20.85	20.85	4.62	5.12
	214	1971	16.71	16.72	5.62	5.87
	224	1971	20.70	20.70	4.12	4.12
	242	1971	20.24	20.10	4.50	5.37

Lake	Day	Year	Surface temp	Epi temp	Epi depth	Planar thermocline
	192	1972	21.00	21.00	3.37	3.87
	227	1972	19.97	19.97	4.50	5.87
	185	1975	24.47	24.47	3.37	5.62
	195	1975	20.71	20.71	4.25	5.25
	223	1975	20.53	20.53	5.12	5.37
	195	1976	21.84	21.88	4.62	4.62
	223	1976	20.96	20.96	5.12	5.87
	193	1977	20.48	20.50	4.62	5.12
	221	1977	20.03	20.13	5.12	6.12
	199	1978	21.25	21.25	3.37	5.37
	227	1978	21.33	21.33	4.62	5.87
	186	1980	19.30	19.30	5.12	5.12
	204	1980	22.25	22.25	4.62	5.12
	225	1980	21.50	21.50	5.12	6.62
	195	1981	23.53	23.42	3.25	6.12
	209	1981	21.23	21.20	5.12	6.12
	223	1981	21.94	21.90	5.12	5.62
	237	1981	21.52	21.50	5.62	6.37
	188	1982	19.93	19.91	5.12	6.62
	203	1982	22.04	22.04	5.12	6.37
	216	1982	21.65	21.65	5.12	6.37
	230	1982	21.11	21.16	5.12	6.87
	244	1982	16.28	16.31	7.12	7.87
	195	1983	22.90	22.80	4.12	5.87
	209	1983	23.80	23.80	4.37	4.87
	223	1983	22.60	22.70	5.12	5.62
	237	1983	21.90	21.90	5.37	6.37
261						
	200	1971	21.45	21.10	3.12	3.37
	235	1971	19.80	19.70	3.75	4.25
	238	1971	19.65	19.14	4.12	4.12
	206	1972	20.41	20.44	3.25	3.75
	241	1972	21.84	21.58	1.50	3.75
	184	1973	20.39	20.27	2.50	3.62
	198	1973	21.66	21.48	3.12	3.62
	205	1973	22.69	22.86	3.12	3.12
	212	1973	18.59	18.45	3.50	4.62
	219	1973	24.06	24.07	1.50	4.75
	226	1973	22.48	22.37	2.50	3.62
	233	1973	23.63	23.42	2.50	4.50
	240	1973	24.34	23.67	2.50	3.12

Lake	Day	Year	Surface temp	Epi temp	Epi depth	Planar thermocline
	205	1974	24.23	24.16	2.25	3.87
	228	1974	19.45	19.34	3.25	3.62
	184	1975	24.68	24.53	1.50	2.87
	198	1975	26.24	25.78	1.50	3.12
	212	1975	25.00	24.99	1.50	3.37
	226	1975	20.19	20.25	3.12	4.12
	240	1975	17.01	17.10	3.62	3.87
	183	1976	22.08	21.67	2.12	3.37
	190	1976	24.36	24.00	2.12	2.87
	197	1976	21.58	21.59	3.12	3.37
	204	1976	21.56	21.58	2.25	4.12
	211	1976	22.42	22.44	2.87	3.37
	218	1976	20.43	20.46	3.37	3.62
	225	1976	21.26	21.27	2.25	4.37
	232	1976	23.38	22.35	0.50	4.37
	239	1976	23.15	23.18	2.25	4.37
	187	1977	21.76	21.73	2.12	2.87
	215	1977	19.78	19.83	3.37	4.37
	243	1977	17.22	17.26	4.12	4.62
	193	1978	21.16	21.24	2.12	3.12
	221	1978	20.34	20.39	2.25	4.37
302 N						
	195	1972	21.70	21.70	3.50	4.25
	209	1972	20.85	20.53	4.25	5.12
	223	1972	18.38	18.38	5.12	5.37
	237	1972	20.12	20.11	4.50	5.75
	183	1973	20.95	20.88	2.50	4.87
	197	1973	20.90	20.95	4.12	4.87
	211	1973	19.17	19.22	5.12	5.87
	218	1973	22.10	22.40	5.25	5.75
	225	1973	21.08	21.08	4.25	6.87
	239	1973	21.84	21.72	4.25	5.62
	184	1974	21.72	21.75	3.12	3.87
	212	1974	19.78	19.80	4.25	4.62
	238	1974	17.21	17.30	5.12	6.12
	190	1975	22.08	22.37	3.25	3.62
	204	1975	22.95	22.97	3.37	4.12
	218	1975	21.68	21.77	4.12	4.37
	232	1975	18.80	18.85	4.75	5.12
	196	1976	21.96	21.98	3.25	3.87
	210	1976	22.60	22.79	3.62	4.37
	224	1976	21.30	21.29	4.37	5.12
	238	1976	22.95	22.72	3.25	6.12

Lake	Day	Year	Surface temp	Epi temp	Epi depth	Planar thermocline
	207	1978	21.82	21.82	3.62	4.37
	235	1978	17.86	17.96	5.12	5.62
	190	1980	20.57	20.57	4.12	4.87
	218	1980	21.20	21.22	5.12	5.87
	188	1981	24.48	24.48	2.12	2.12
	202	1981	22.50	22.55	4.12	4.12
	216	1981	22.56	22.54	4.12	4.87
	230	1981	20.97	20.97	4.87	5.62
	244	1981	19.57	19.70	5.37	6.12
	194	1982	21.73	21.73	2.37	4.87
	208	1982	23.13	23.00	3.12	4.12
	222	1982	19.30	19.42	4.37	4.87
	236	1982	19.84	20.05	4.12	4.87
	193	1983	20.60	20.60	3.12	3.87
	207	1983	24.60	24.50	2.50	3.87
	214	1983	22.90	22.90	3.12	3.87
	221	1983	23.90	23.90	3.62	4.37
	236	1983	22.10	22.00	4.12	4.87
302 S						
	181	1972	21.71	21.66	1.50	4.12
	195	1972	21.51	21.39	3.50	4.87
	209	1972	20.66	20.64	4.25	4.62
	223	1972	18.58	18.58	5.12	5.62
	237	1972	20.80	20.80	4.50	5.75
	183	1973	20.92	20.88	1.50	4.62
	197	1973	20.98	20.92	4.12	4.87
	211	1973	18.95	19.04	4.50	5.37
	225	1973	20.80	20.85	4.25	5.87
	239	1973	21.72	21.65	4.25	5.12
	184	1974	21.61	21.68	3.12	3.37
	212	1974	19.96	19.99	4.12	4.62
	238	1974	17.55	17.55	5.62	5.87
	190	1975	22.32	22.37	3.25	3.62
	204	1975	23.05	23.11	3.37	5.62
	218	1975	21.92	21.97	4.12	4.62
	232	1975	19.26	19.26	5.12	5.37
	196	1976	22.35	22.25	4.12	4.37
	210	1976	22.84	22.88	4.12	5.12
	224	1976	21.68	21.66	5.12	6.37
	238	1976	22.65	22.61	4.37	6.87
	207	1978	21.82	21.82	3.75	4.87
	235	1978	18.27	18.30	5.62	6.37

Lake	Day	Year	Surface temp	Epi temp	Epi depth	Planar thermocline
	190	1980	20.79	20.69	4.12	5.87
	218	1980	21.39	21.42	5.37	5.87
	188	1981	24.36	24.35	2.12	7.12
	202	1981	22.78	22.82	4.12	4.87
	216	1981	22.91	22.78	4.12	5.62
	230	1981	21.30	21.30	5.37	6.62
	244	1981	20.90	20.90	5.87	6.62
	194	1982	21.68	21.66	3.12	4.87
	208	1982	22.92	22.92	3.50	5.62
	222	1982	20.20	20.21	5.12	5.87
	236	1982	20.08	20.22	5.12	5.62
	193	1983	20.45	20.50	4.12	7.62
	207	1983	24.50	24.50	4.12	6.62
	214	1983	23.00	23.00	4.87	7.37
	221	1983	24.00	24.10	5.37	5.62
	236	1983	22.60	22.50	6.37	7.12
304						
	184	1969	18.00	17.80	1.50	3.50
	196	1969	23.31	22.98	1.50	2.50
	210	1969	22.70	22.40	2.50	3.50
	227	1969	20.00	19.80	2.50	3.50
	238	1969	23.76	23.69	1.50	3.50
	208	1970	22.80	22.85	1.50	2.75
	188	1971	21.57	21.51	2.37	3.37
	195	1971	21.49	21.45	2.62	3.37
	202	1971	21.93	21.96	2.25	3.37
	209	1971	17.72	17.80	3.12	3.37
	216	1971	17.97	17.85	3.12	4.62
	223	1971	21.41	21.40	1.50	3.12
	230	1971	21.98	21.75	1.25	3.37
	237	1971	19.15	19.20	2.50	3.12
	244	1971	19.36	19.35	2.25	3.37
	187	1972	21.57	20.90	0.25	2.87
	194	1972	22.54	22.45	2.25	3.62
	208	1972	20.30	20.16	2.50	3.62
	222	1972	18.54	18.41	3.12	3.62
	228	1972	19.74	19.75	2.50	3.62
	236	1972	22.83	20.48	0.25	3.62
	192	1973	23.00	22.72	2.12	3.37
	206	1973	21.28	21.28	2.25	3.37
	220	1973	22.52	22.50	1.50	3.37
	234	1973	21.53	21.57	2.62	3.37

Lake	Day	Year	Surface temp	Epi temp	Epi depth	Planar thermocline
	191	1974	24.50	24.50	1.75	2.62
	219	1974	21.70	21.60	1.50	3.62
	183	1975	24.33	24.05	1.50	3.87
	197	1975	26.15	23.42	0.50	2.62
	211	1975	25.90	25.55	1.50	3.37
	225	1975	20.63	20.63	2.37	3.12
	239	1975	17.64	17.68	3.25	4.62
	189	1976	23.87	23.40	1.62	2.12
	203	1976	22.28	21.85	2.12	2.87
	217	1976	22.35	22.29	2.12	3.12
	231	1976	22.31	21.60	2.50	3.37
	186	1977	22.49	22.60	1.62	2.87
	200	1977	26.15	24.73	0.50	3.37
	214	1977	19.52	19.57	2.75	3.12
	228	1977	17.50	17.41	3.25	3.75
	242	1977	17.38	17.38	3.12	4.87
305						
	187	1968	18.30	18.10	6.50	6.50
	188	1969	17.40	17.30	7.50	9.50
	203	1969	21.80	21.80	4.50	4.50
	239	1969	23.00	22.60	6.50	7.50
	187	1971	20.53	20.47	5.50	6.25
	215	1971	19.00	18.90	7.75	8.25
	243	1971	19.42	19.51	7.25	8.75
382	187	1977	22.36	22.20	3.25	5.87
	215	1977	20.31	20.31	5.12	5.62
	243	1977	17.15	17.20	6.37	6.62
	193	1978	20.78	20.78	4.12	4.12
	221	1978	19.20	19.31	4.87	5.62
	184	1979	21.39	21.42	2.87	4.12
	212	1979	21.54	21.60	4.12	4.87
	240	1979	18.01	18.05	5.12	6.12
	197	1980	23.04	23.05	3.37	3.37
	225	1980	21.50	21.55	5.12	11.12
	207	1983	24.10	24.10	3.87	4.12
	235	1983	20.40	20.40	5.12	5.87
383						
	192	1974	23.60	23.50	1.50	2.87
	213	1974	19.00	19.18	3.12	3.37
	196	1975	20.45	20.44	2.12	3.62
	224	1975	20.89	20.84	3.25	4.87